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PHOSPHORUS AND MICRONUTRIENTS FERTILIZATION IMPACT ON FABA BEAN PRODUCTIVITY (*Vicia faba* L.)

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ABSTRACT: This investigation was carried out in a demonstrated field at Al-Ibrahimia district, El-Sharkia Governorate, Egypt, during 2014/2015 and 2015/2016 winter seasons to study the impact of three phosphorus levels (check, 15.5 and 31 kg P_2O_5/fad.) and five micronutrient spraying treatments [Zn, Mn, Fe, Zn + Mn + Fe and control (tap water)] on faba bean yield (*Vicia faba* L. cv. Giza 843) and seed protein content. The obtained results could be summarized as follows: Raising phosphorus level to 31 kg P_2O_5/fad., significantly increased number of pods per plant, number of seeds per pod and plant, as well as seed and stover yields per fad. Whereas, 100-seed weight and seed protein content were significantly decreased. However, plant height was not significantly affected by phosphorus levels. Micronutrients spraying reflected significant increase in seed yield and yield attributes. The foliar application of any of the following micronutrient treatments *i.e.* Mn, Fe and Zn + Mn + Fe had significant effect on seed yield per fad., while, micronutrient spraying treatments had insignificant effect on number of branches per plant and seed protein content compared with the control treatment. The interaction between the two factors had significant effects on yield and its components, where the highest seed yield per fad., (13.79 ardab) was achieved by addition of 31 kg P_2O_5/fad., with Mn foliar application (0.4 g/l).

Key words: Faba bean, phosphorus, micronutrients, seed protein content.

INTRODUCTION

In Egypt, faba bean (*Vicia faba* L.) is one of the most important pulse crops where, cultivated area reached 37677 ha which produced 134175 ton (FAOSTAT, 2016). Phosphorus is essential element for improving root growth, photosynthetic assimilation, phospho-proteins, phospho-lipids and ATP, ADP formation (Devlin and Witham, 1986). Tageldin and Mehasen (2004), Tayel and Sabreen (2011) and Jafar (2014) found that the application of phosphorus fertilizer increased the yield and yield components of faba bean. Several authors reported significant increase of seed yield and yield attributes due to the increase of P level up to 22.5, 45, 30, 25, 33.6, 31 kg P_2O_5/fad., as reported by Hamed (2003), Ahmed and El-Abagy (2007), El-Gizawy and Mehasen (2009), Weldua *et al*. (2012), Hashemabadi (2013) and Mousa and El-Sayed (2016), respectively. Furthermore, Shakori and Sharifi (2016) showed that, highest value of seed yield of faba bean was obtained by addition of 63 kg P_2O_5/fad.

Micronutrients are essential elements for growth, fruiting and hence play an important role in enzymes function in plants (Mengel *et al*., 2001; Fageria, 2009). Also, the enhancing effects of Fe, Mn and Zn on plant could be due to their effects as a metal component of enzymes or regulatory for the others involved in photosynthesis and other physiological processes as well as plays a major role as antioxidants (Abd El-Hady, 2007; Millaleo *et al*., 2010). El-Gizawy and Mehasen (2009), Mady (2009) and Bozorgi *et al*. (2011) reported that foliar spraying with zinc at 400, 75 and 1000 ppm can be used to increase seed yield and

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seed quality of faba bean plants, respectively. Aslo, Weldua *et al*. (2012) found that Zn fertilization significantly increased pod number per plant and above ground biomass at maturity stage of faba bean, but, it did not affect seed yield and yield components. Moreover, El-Hosary and Mehasen (1998), El-Masri *et al*. (2002) and Atiia *et al*. (2016) showed that foliar application with micronutrients had significantly increased faba bean yield and yield attributes as well as seed quality. Usama *et al*. (2013) reported that foliar application with Fe + Zn + Mn increased yield and yield components of faba bean. Also, Salem *et al*. (2014) showed positive effect of micronutrients spraying on the yield and yield attributes of faba bean except branch number per plant and number of seeds per pod.

Therefore, the present study aimed to investigate the impact of P fertilization and micronutrients foliar spraying on faba bean yield and seed protein content.

MATERIALS AND METHODS

The present study was conducted in a demonstrated field at Al-Ibrahimia district, El-Sharkia Governorate, Egypt, during 2014/2015 and 2015/2016 winter seasons. The study aimed to investigate the impact of three phosphorus (P) levels and five micronutrient spraying treatments on faba bean yield (*Vicia faba* L. cv. Giza 843) and seed protein content.

Experimental Design and Agronomic Practices

A split plot design of four replications was used, where P fertilizer levels (check, 15.5 and 31 kg P_2O_5/fad.) were allocated in the main plots where, phosphorus as ordinary superphosphate (15.5% P_2O_5) was band placed at planting. Micronutrient treatments [Zn, Mn, Fe, Zn + Mn + Fe and control (tap water)] were allocated in sub plots (14 m^2). Micronutrients *i.e.* Zn EDTA (13% Zn), Mn EDTA (13% Mn) and Fe EDTA (12% Fe) were applied twice at 45 and 60 days after sowing (DAS), respectively at 0.04% (0.4 g/l). Micronutrient treatments were carried out using tap-water (250 L/fad./ spray). Faba bean cultivar (Giza 843) was planted on October 21th and 25th in the two seasons, respectively. Each sub plot (3.5 m x 4 m) included 5 ridges 70 cm apart. Faba bean seeds were hand sown in hills 20 cm apart on the two sides of the ridge. Planting took place after corn (*Zea mays* L.) as a preceding crop in both seasons using seeding rates of 40 kg/fad., and the plants were thinned to two plants per hill (120000 plants/fad.) before the first irrigation (40 DAS). Soil samples were collected from the experimental sites at the depth of 0 -30 cm before planting to determine soil physical and chemical properties (Central Laboratory, Faculty of Agriculture, Zagazig University, Zagazig, Egypt). The analyses of the soil, showed that the soil was clay in texture, organic matter (2.0%), total N (0.15%), available P (17 ppm), available K (140 ppm), available Fe (2.0 ppm), available Zn (1.0 ppm), available Mn (1.8 ppm) and pH (7.9 "moderately alkaline") (average of both seasons).

Sampling and Studied Traits

At harvest, the following yield attributes were recorded on ten guarded plants: plant height (cm), branch number per plant, pod number per plant, seed number per pod, seed number per plant (calculated) and 100- seed weight (g). Also, the following final yield traits were recorded from the two central ridges: seed yield (ardab/fad.) and stover yield (ton/fad.). Seed samples at harvest were dried at 70° C up to constant weight where their contents from total N was determined using the colorimeterical method according to Jackson (1967) where, seed protein content was determined by multiplying N percentage x 6.25.

Statistical Analysis

Data were statistically analyzed according to Steel *et al*. (1997) by using MSTAT-C (1991) where statistical program Version 2.1 was used for analysis of variance (ANOVA). A combined analysis was undertaken for the data of the two seasons after test the homogenity of error mean squares by Bartlett's test (Steel *et al*., 1997). Duncan Multiple range test was used to compare statistical significant differences (Duncan, 1955). In interaction Tables, capital letters were used to denote significant differences among rows, while small letters were used to compare the values in columns.

RESULTS AND DISCUSSION

Plant Height and Number of Branches Per Plant

Phosphorus level effect

Plant height was not significantly affected by P levels in both seasons and their combined data. However, number of branches per plant was increased due to addition of 15.5 P_2O_5/fad., in both seasons and their combined analysis (Table 1). In the second season and the combined analysis, addition of 15.5 or 31 P_2O_5/ fad., recorded at par significant increase in number of branches per plant. These results are in harmony with those obtained by Hamed (2003), Ahmed and El-Abagy (2007), Tayel and Sabreen (2011) and Jafar (2014).

Micronutrient treatments effect

Foliar application of micronutrients mixture *i.e.* (Zn+Mn+Fe) caused significant increase in plant height in both seasons and their combined analysis (Table 1). However, in both seasons and their combined analysis, micronutrient treatments had significant impact on branch number per plant, wherein that number was decreased due to Fe application in both seasons and their combined analysis. A look in the soil analysis showed that experimental soil was moderate in organic matter content (2.0%) and hence, this might play an important role in enriching soil fertility and availability of micronutrient elements. Similar significant effects was reported by El-Hosary and Mehasen (1998), El-Masri *et al*. (2002) and Atiia *et al*. (2016), as they showed that, foliar application with micronutrients had significantly increased yield attributes of faba bean. Salem *et al*. (2014) showed positive effect of micronutrients spraying on the yield and yield attributes of faba bean except branch number per plant.

Interaction effect

The combined analysis detected significant P × M interaction impact on number of branches per plant as shown in Table 1-a. Regarding number of branches per plant (Table 1-a), foliar application of Fe or micronutrients mixture treatment caused significant decrease in number of branches per plant under the check P treatment. It seems possible that added micronutrient as mixture might caused antagonistic ions effect so, this might have made nutrients unavailable for faba bean plants. However, foliar application with Zn or Mn had insignificant effect on the number of branches per plant compared with the control treatment. On the other hand, the highest number of branches per plant (7.25) was achieved by the foliar application of Mn or micronutrients mixture treatment when P fertilizer level added was 15.5 kg P_2O_5/fad.

Pod Number/ Plant, Seed Number/ Pod, Seed Number/Plant and 100-Seed Weight

Phosphorus level effect

The increase of P levels to up 31 kg P_2O_5/fad., had positive and significant effect on each of number of pods per plant, number of seeds per pod and per plant. However, the increase of P level caused significant decrease in 100-seed weight in both seasons and their combined analysis (Table 2). The increase of the P level up to 31 kg P_2O_5/fad., might caused an increase in number of seeds (sink size) per pod which was over the capacity of the faba bean plant (source) where a large number had been failed to fill all seeds per plant. Similar findings were reported by El-Gizawy and Mehasen (2009), Weldua *et al*. (2012), Hashemabadi (2013), as well as, Mousa and El-Sayed (2016).

Micronutrient treatments effect

The micronutrients foliar application gave significant increase in each of number of pods per plant, number of seeds per pod and per plant, as well as, 100-seed weight (Table 2). Results of the second season and combined analysis detected significant increase in number of pods per plant due to application of micronutrients mixture. Foliar application of Mn had significant increase on number of seeds per pod in both seasons and their combined. Moreover, in both seasons and the combined analysis significant increase in number of seeds per plant due to the foliar application of Zn+Mn+Fe was observed. Also, 100-seed weight was significantly increased due to either sole Mn foliar application or mixture of Zn+Mn+Fe foliar application. This possibly explains the higher efficiency of micronutrients foliar application in

Table 1. Plant height and number of branches per plant of faba bean as affected by phosphorus fertilizer levels and micronutrient treatments and their interaction in both seasons and their combined

Main effects and interaction	Plant height (cm)			Number of branches/ plant		
	2014/2015	2015/2016	Comb.*	2014/2015	2015/2016	Comb.
Phosphorus level (P)						
Check	152.3	152.3	152.3	6.04 c	6.41 b	6.23 b
15.5 kg P_2O_5/fad.	151.7	150.3	151.0	6.79 a	6.96 a	6.88 a
31 kg P_2O_5/fad.	154.2	149.8	152.0	6.65 b	7.05 a	6.85 a
F. test	NS	NS	NS	**	**	**
Micronutrient treat. (M)						
Tap water (control)	153.1 b	149.7 c	151.4 b	6.56 a	7.11 a	6.83 a
Zn	152.6 b	149.6 c	151.1 b	6.53 a	6.64 b	6.58 a
Mn	152.0 bc	151.3 ab	151.7 b	6.75 a	7.08 a	6.92 a
Fe	151.0 c	150.7 bc	150.8 b	6.07 b	6.35 c	6.21 b
Zn + Mn + Fe	155.0 a	152.7 a	153.8 a	6.57 a	6.85 b	6.71 a
F.test	**	**	**	**	**	**
Interaction:						
P x M	**	NS	NS	**	**	**(1-a)

** and NS indicate statistically significant at 0.01 level and not significant of differences, respectively.

* Comb. : combined

Table 1-a. Number of branches per plant of faba bean as affected by the interaction between phosphorus fertilizer level and micronutrient treatments (combined data)

P level	Micronutrient treatments				
	Tap water (control)	Zn	Mn	Fe	Zn + Mn + Fe
Check	A	A	A	B	B
	6.50 b	6.38 b	6.50 b	6.0 b	5.75 b
15.5 kg P_2O_5/ fad.	A	A	A	B	A
	7.0 a	6.75 a	7.25 a	6.13 b	7.25 a
31 kg P_2O_5/ fad.	A	B	A	B	A
	7.0 a	6.63 ab	7.0 a	6.50 a	7.13 a

Table 2. Number of pods per plant, number of seeds per pod and plant as well as 100-seed weight of faba bean as affected by phosphorus fertilizer levels and micronutrient treatments and their interaction in both seasons and their combined

Main effects and interaction	Number of pods/ plant			Number of seeds/ pod			Number of seeds/plant			100- seed weight (g)		
	2014/ 2015	2015/ 2016	Comb.	2014/ 2015	2015/ 2016	Comb.	2014/ 2015	2015/ 2016	Comb.	2014/ 2015	2015/ 2016	Comb.
Phosphorus level (P)												
Check	26.81c	29.79b	28.30c	3.45c	3.35c	3.40c	92.43c	99.27c	95.85c	75.77a	75.48a	75.63a
15.5 kg P_2O_5/ fad.	29.86b	31.41a	30.63b	3.66b	3.74b	3.70b	109.8b	117.6b	113.7b	74.49b	75.04a	74.76b
31 kg P_2O_5/ fad.	31.16a	32.05a	31.60a	4.04a	4.04a	4.04a	125.9a	129.5a	127.7a	73.59c	74.12b	73.85c
F.test	**	**	**	**	**	**	**	**	**	**	**	**
Micronutrient treat. (M)												
Tap water (control)	29.45	30.78bc	30.11b	3.50d	3.63c	3.57c	103.6b	112.7b	108.2c	70.52c	73.61bc	72.07c
Zn	27.94	32.17ab	30.06b	3.68c	3.72b	3.70b	103.3b	119.6a	111.5bc	71.18c	72.27c	71.73c
Mn	29.61	28.95d	29.28b	3.91a	3.82a	3.87a	116.1a	110.7b	113.4ab	78.08a	77.16a	77.62a
Fe	29.96	30.26cd	30.11b	3.72bc	3.68bc	3.70b	112.2a	112.0b	112.1bc	75.05b	73.69b	74.37b
Zn + Mn + Fe	29.41	33.26 a	31.33a	3.78b	3.69bc	3.73b	111.7a	122.3a	117.0a	78.25a	77.65a	77.95a
F.test	NS	**	**	**	**	**	**	**	**	**	**	**
Interaction												
P × M	**	**	**(2-a)	**	**	**(2-b)	**	**	**(2-c)	**	**	**(2-d)

** and NS indicate statistically significant at 0.01 level and not significant of differences, respectively.

increasing seed set and filling. Similar significant effects were reported by Usama *et al*. (2013) and Salem *et al*. (2014) but, results in this study were not in accordance with those reported by El-Hosary and Mehasen (1998), El-Masri *et al*. (2002) and Atiia *et al*. (2016) as they reported that, the foliar spraying with zinc had significantly increased faba bean yield and its components as well as seed quality.

Interaction effect

Insignificant differences in pod number/plant were observed due to application of micronutrient treatments under the three phosphorus fertilizer levels used with the exception of the two micronutrient treatments Fe and Zn + Mn + Fe under phosphorus deficiency (check level), wherein foliar application of Zn + Mn + Fe in combination elevated pod number/ plant. On the other direction, raising pod number/plant was achieved *via* increasing P level up to 31 kg P_2O_5/fad., under foliar application of tap water (control) or increasing P level up to 15.5 P_2O_5/fad., with foliar application of either Mn or Fe. Regarding to number of seeds/pod and per plant, impact of micronutrient application was fluctuated under the three P levels tested. The impact of increasing P level under most of micronutrient treatment was accompanied with significant increase in seed number/pod and seed number/plant. Results in Table 2-d clearly indicate that, 100- seed weight was significantly affected by the foliar application of micronutrients under the different P levels. The heaviest seed index (79.75 g) was achieved by the check treatment with the foliar application of Zn + Mn + Fe, otherwise, the lightest one (69.53 g) was recorded by 15.5 kg P_2O_5/fad., with control treatment.

Seed and Stover Yields Per Fad., and Seed Protein Content

Phosphorus level effect

The addition of 31 kg P_2O_5/fad., was followed by a significant increase in seed and stover yields per fad., though, seed yield per fad., was not significantly affected by P levels in the first season (Table 3). Similar significant increases were observed in almost yield attributes (Table 2). The first season and the combined analysis

Table 2-a. Number of pods per plant of faba bean as affected by the interaction between phosphorus fertilizer levels and micronutrient treatments (combined data)

P level	Micronutrient treatments				
	Tap water (control)	Zn	Mn	Fe	Zn + Mn + Fe
Check	AB	AB	AB	B	A
	28.67 b	28.83 a	26.84 b	26.0 b	31.17 a
15.5 kg P_2O_5/ fad.	A	A	A	A	A
	29.17 b	31.50 a	31.0 a	31.5 a	30.0 a
31 kg P_2O_5/ fad.	A	A	A	A	A
	32.50 a	29.84 a	30.0 a	32.84 a	32.83 a

Table 2-b. Number of seeds per pod of faba bean as affected by the interaction between phosphorus fertilizer levels and micronutrient treatments (combined data)

P level	Micronutrient treatments				
	Tap water (control)	Zn	Mn	Fe	Zn + Mn + Fe
Check	B	B	A	B	B
	3.30 c	3.20 c	3.80 a	3.40 c	3.30 c
15.5 kg P_2O_5/ fad.	B	A	A	AB	A
	3.50 b	3.80 b	3.90 a	3.60 b	3.70 b
31 kg P_2O_5/ fad.	B	A	B	A	A
	3.90 a	4.10 a	3.90 a	4.10 a	4.20 a

Table 2-c. Number of seeds per plant of faba bean as affected by the interaction between phosphorus fertilizer levels and micronutrient treatments (combined data)

P level	Micronutrient treatments				
	Tap water (control)	Zn	Mn	Fe	Zn + Mn + Fe
Check	AB	AB	A	B	A
	94.73 b	92.30 b	102.0 b	88.40 c	101.9 b
15.5 kg P_2O_5/ fad.	B	A	A	AB	AB
	102.9 b	119.7 a	121.2 a	113.4 b	111.2 b
31 kg P_2O_5/ fad.	AB	AB	B	A	A
	126.8 a	122.4 a	117.0 a	134.5 a	137.9 a

Table 2-d. 100-seed weight (g) of faba bean as affected by the interaction between phosphorus fertilizer levels and micronutrient treatments (combined data)

P level	Micronutrient treatments				
	Tap water (control)	Zn	Mn	Fe	Zn + Mn + Fe
Check	B	C	A	A	A
	73.01 a	68.49 c	79.26 a	77.62 a	79.75 a
15.5 kg P_2O_5/ fad.	B	A	A	A	A
	69.53 b	74.84 a	76.67 b	75.16 a	77.61 ab
31 kg P_2O_5/ fad.	B	B	A	B	A
	73.66 a	71.85 b	76.93 ab	70.34 b	76.49 b

Table 3. Seed and stover yields per fad., and seed protein content of faba bean as affected by phosphorus fertilizer levels and micronutrient treatments and their interaction in both seasons and their combined

Main effects and interaction	Seed yield (ardab*/fad.)			Stover yield (ton/fad.)			Seed protein content (%)		
	2014/ 2015	2015/ 2016	Comb.	2014/ 2015	2015/ 2016	Comb.	2014/ 2015	2015/ 2016	Comb.
Phosphorus level (P)									
Check	11.96	12.95 b	12.46 b	5.18 c	5.66 b	5.42 b	27.74 a	27.80	27.77 a
15.5 kg P_2O_5/fad.	12.33	12.59 b	12.46 b	5.39 b	5.55 b	5.47 b	26.43 b	27.01	26.72 b
31 kg P_2O_5/fad.	12.24	13.45 a	12.84 a	5.72 a	6.01 a	5.87 a	25.95 b	27.47	26.71 b
F.test	NS	**	**	**	**	**	**	NS	**
Micronutrient treat. (M)									
Tap water (control)	11.73 c	12.90 b	12.32 b	5.35 c	5.50 c	5.42 c	27.07	28.87 a	27.97 a
Zn	10.5 6 d	12.41 c	11.48 c	5.24 c	5.37 c	5.31 c	26.65	27.83 a	27.24 a
Mn	13.30 a	12.91 b	13.11 a	5.65 a	6.06 a	5.85 a	26.92	25.85 b	26.38 b
Fe	12.99 a	13.05 b	13.02 a	5.53 ab	5.82 b	5.67 b	25.97	26.32 b	26.15 b
Zn + Mn + Fe	12.30 b	13.72 a	13.01 a	5.38 bc	5.96 ab	5.67 b	26.90	28.26 a	27.58 a
F.test	**	**	**	**	**	**	NS	**	**
Interaction									
P × M	**	**	**(3-a)	**	**	**(3-b)	NS	**	NS

** and NS indicate statistically significant 0.01 level and not significant of differences, respectively.

* ardab = 155 kg

detected significant decrease in seed protein content due to addition of P fertilizer levels which had at par averages compared with the check treatment, but, it was not significantly affected by P levels in the second season. The decrease of seed protein content could be attributed to a dilution effect caused by the increase of seed yield per fad., observed herein. These results are in harmony with those obtained by El-Gizawy and Mehasen (2009), Tayel and Sabreen (2011) Weldua *et al*. (2012), Hashemabadi (2013), Jafar (2014) as well as Mousa and El-Sayed (2016).

Micronutrient treatments effect

The foliar application of any of the following micronutrient treatments, *i.e.,* Mn, Fe and Zn + Mn + Fe had significant effect on seed yield per fad., as indicated by the combined analysis (Table 3). Moreover, in the both seasons and their combined, stover yield per fad., was significantly increased due to the foliar application of Mn. Whereas, in the second season and the combined analysis, the foliar application with tap water, Zn and mixture of micronutrients significantly produced the highest averages of seed protein content without significant differences among them. On the other hand, it was not significantly affected by micronutrient treatments in the first season. Similar significant effects were reported by Usama *et al*. (2013) and Salem *et al*. (2014) otherwise, results in this study were not in accordance with those reported by El-Masri *et al*. (2002), El-Gizawy and Mehasen (2009), Mady (2009), Bozorgi *et al.* (2011) and Atiia *et al*. (2016) as they reported that, the foliar spraying with zinc can be used to increase yield and seed quality of faba bean.

Interaction effect

The combined analysis detected significant P × M interaction effect on seed and stover yields per fad., as shown in Tables 3-a and 3-b. It is evident from Table 3-a that, seed yield was significantly affected by the P × M interaction effect where, the highest seed yield per fad., (13.79 ardab) was achieved by addition of 31 kg P_2O_5/fad., with Mn foliar application. Otherwise, the lowest seed yield per fad., (10.98 ardab) was recoded by 15.5 kg P_2O_5/fad., with Zn foliar application. It is evident from Table 3-b that, stover yield per fad., was, also, significantly affected by the P × M interaction. The highest stover yield per fad., (6.08 ton) was achieved by addition of 31 kg P_2O_5/fad., with Zn+Mn+Fe foliar application, while, the lowest one (4.90 ton) was recoded by the check treatment with Zn foliar application. This interaction effect strength the view that addition of P along with the foliar application of Zn might have had reflected an antagonistic effect caused probably by different chelating interaction effects and hence had decreased seed and stover yields per fad.

Table 3-a. Seed yield (ardab/fad.) of faba bean as affected by the interaction between phosphorus fertilizer levels and micronutrient treatments (combined data)

P level	Micronutrient treatments				
	Tap water (control)	**Zn**	**Mn**	**Fe**	**Zn + Mn + Fe**
Check	A	B	A	AB	AB
	12.97 a	11.71 a	13.31 a	12.44 b	11.86 b
15.5 kg P_2O_5/ fad.	B	C	B	A	A
	12.17 ab	10.98 a	12.22 b	13.24 ab	13.70 a
31 kg P_2O_5/ fad.	B	B	A	A	A
	11.81 b	11.76 a	13.79 a	13.38 a	13.48 a

Table 3-b. Stover yield (ton/fad.) of faba bean as affected by the interaction between phosphorus fertilizer levels and micronutrient treatments (combined data)

P level	Micronutrient treatments				
	Tap water (control)	Zn	Mn	Fe	Zn + Mn + Fe
Check	B	C	A	B	B
	5.33 ab	4.90 b	6.08 a	5.34 b	5.45 b
15.5 kg P_2O_5/ fad.	A	B	A	A	A
	5.65 a	5.05 b	5.57 b	5.61 b	5.48 b
31 kg P_2O_5/ fad.	B	A	A	A	A
	5.30 b	5.98 a	5.92 a	6.07 a	6.08 a

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تأثير التسميد الفوسفاتي والعناصر الصغري على إنتاجية الفول البلدي

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أُجريت هذه الدراسة بحقل إرشادي بمركز الإبراهيمية محافظة الشرقية وذلك خلال الموسمين الزراعيين ٢٠١٤/ ٢٠١٥ – ٢٠١٥/٢٠١٦ لدراسة تأثير ثلاثة مستويات من السماد الفوسفاتي (بدون إضافة، ١٥,٥ كجم فو٢أ٥، ٣١ كجم فو٢أ٥/ فدان) وخمس معاملات من الرش الورقي بالعناصر الصغري (الزنك، المنجنيز، الحديد، الزنك + المنجنيز + الحديد مقارنة بالرش بماء الصنبور فقط) وذلك علي محصول الفول البلدي (صنف جيزة ٨٤٣) ومؤشرات المحصول ومحتوي البذور من البروتين ويمكن تلخيص النتائج المتحصل عليها علي النحو التالي: أدى زيادة معدل السماد الفوسفاتي حتى ٣١ كجم فو٢أ٥/ فدان إلي زيادة معنوية في كل من عدد القرون/النبات، عدد البذور/القرن والنبات وكذلك محصول البذور والحطب/فدان، بينما انخفض وزن ١٠٠ بذرة ومحتوي البذور من البروتين معنوياً، وعلى الجانب الآخر لم يستجيب ارتفاع النبات لإضافة السماد الفوسفاتي، وكان لإضافة العناصر الصغرى (المنجنيز، الحديد و الزنك + المنجنيز + الحديد) تأثيراً معنوياً وايجابياً علي محصول الفول البلدي وبعض مؤشرات المحصول، بينما لم يكن لذلك تأثيراً معنوياً علي محتوي البذور من البروتين مقارنة بالنباتات غير المعاملة، كما لوحظ تداخل فعل معنوي بين عوامل الدراسة علي أغلب الصفات تحت الدراسة، والذي يشير إلى إمكانية استخدام مستوي ٣١ كجم فو٢أ٥/ فدان من السماد الفوسفاتي لمعظمة محصول الفول البلدي (١٣,٧٩ أردب/ فدان) مع الإضافة الورقية للمنجنيز بمعدل ٠,٤ جم/لتر عند ٤٥ و ٦٠ يوم من الزراعة.

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